

# (12) UK Patent Application (19) GB (11) 2 286 647 (13) A

(43) Date of A Publication 23.08.1995

(21) Application No 9501764.6

(22) Date of Filing 30.01.1995

(30) Priority Data

(31) 9402678  
9403226

(32) 11.02.1994  
19.02.1994

(33) GB

(51) INT CL<sup>6</sup>  
F16L 1/20

(52) UK CL (Edition N )  
F2P PL2 P37  
B3E ECB E14K E15T

(56) Documents Cited  
GB 1599865 A US 3872680 A US 3237438 A

(58) Field of Search  
UK CL (Edition N ) B3E ECB , F2P PL2 P2A1  
INT CL<sup>6</sup> F16L 1/12 1/16 1/18 1/20  
ONLINE:WPI

(71) Applicant(s)  
Stena Offshore Limited

(Incorporated in the United Kingdom)

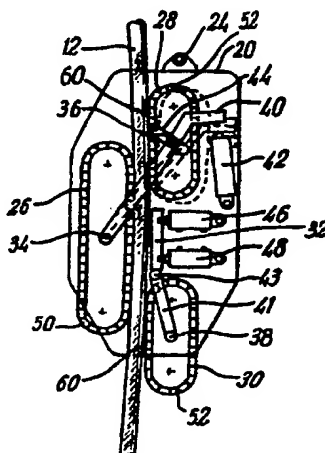
Stena House, Westhill Industrial Estate, Westhill,  
ABERDEEN, AB32 6TQ, United Kingdom

(72) Inventor(s)  
Robert George Martin

(74) Agent and/or Address for Service  
Murgitroyd & Company  
373 Scotland Street, GLASGOW, G5 8QA,  
United Kingdom

## (54) Pipeline straightening apparatus

(57) Pipeline straightening apparatus comprises a first, main straightening roll assembly (26) facing one side of the pipeline (12), a second straightening roll assembly (28) located upstream of the main roll (26) facing the opposite side of the pipeline (12), and a third straightening roll assembly (30) located downstream of the main roll (26) also facing said opposite side of the pipeline (12), said straightening rolls being operable to effect straightening of the pipeline passing therebetween. The apparatus includes pipeline clamping/braking means comprising a brake shoe (32) located between said second and third straightener rolls (28, 30) on the opposite side of said pipeline path from said main straightener roll (26) and actuator means (46, 48) adapted for moving the shoe (32) in a direction substantially perpendicular to the pipeline path towards and away from the pipeline; and/or each of said first, second and third roll assemblies being mounted in a supporting frame for pivotable movement about respective first, second and third pivot axes (34, 36, 38) extending substantially through the longitudinal centres of the respective roll assemblies and substantially at right angles to the plane of pipeline bending.



**FIG. 4**

1/4

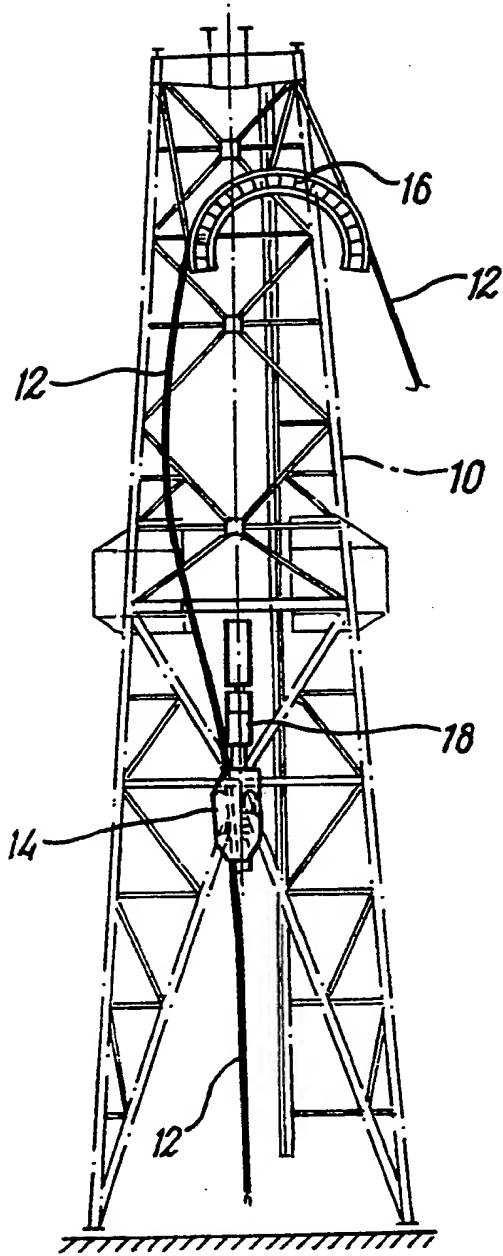


FIG. 1

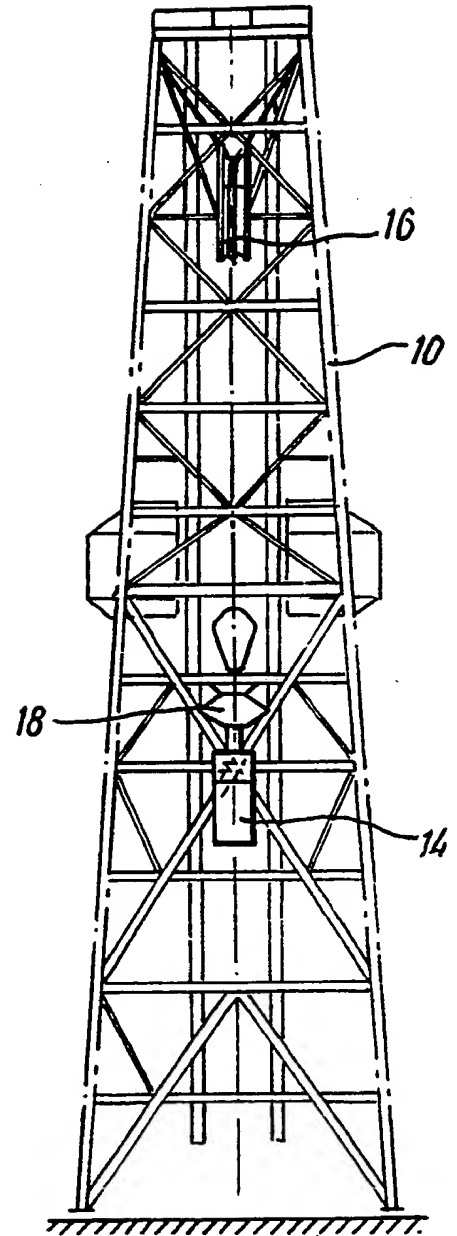
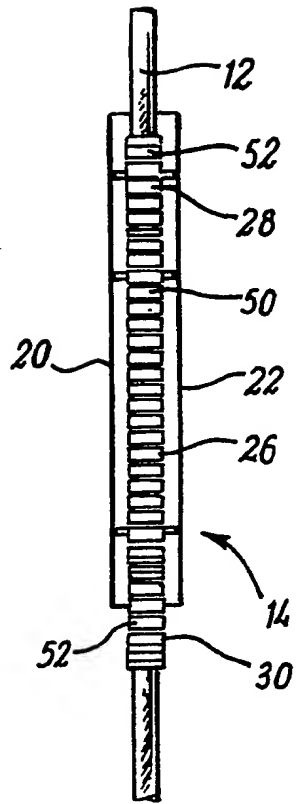
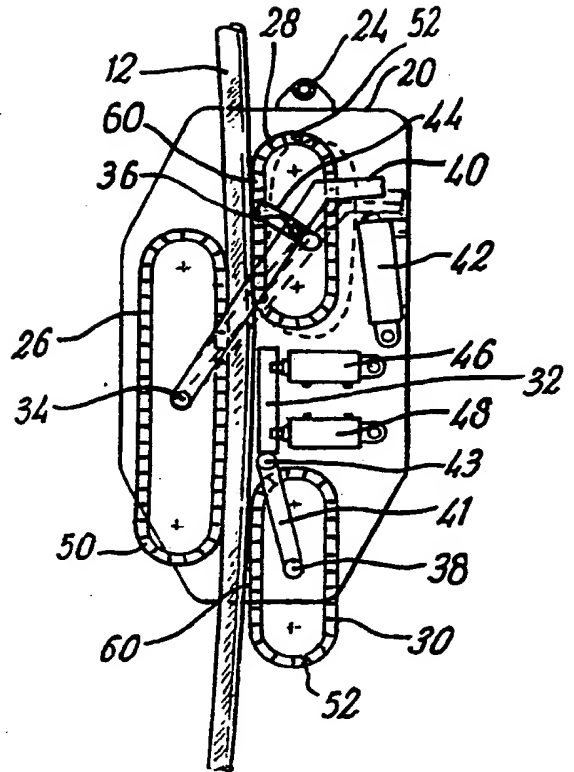


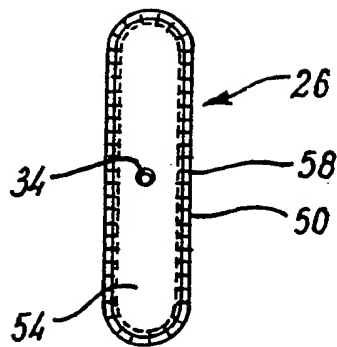
FIG. 2



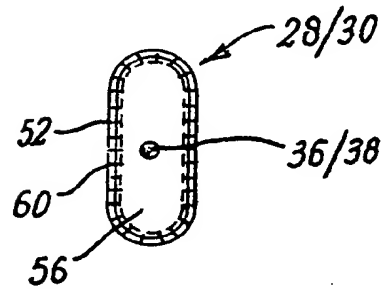
**FIG. 3**



**FIG. 4**

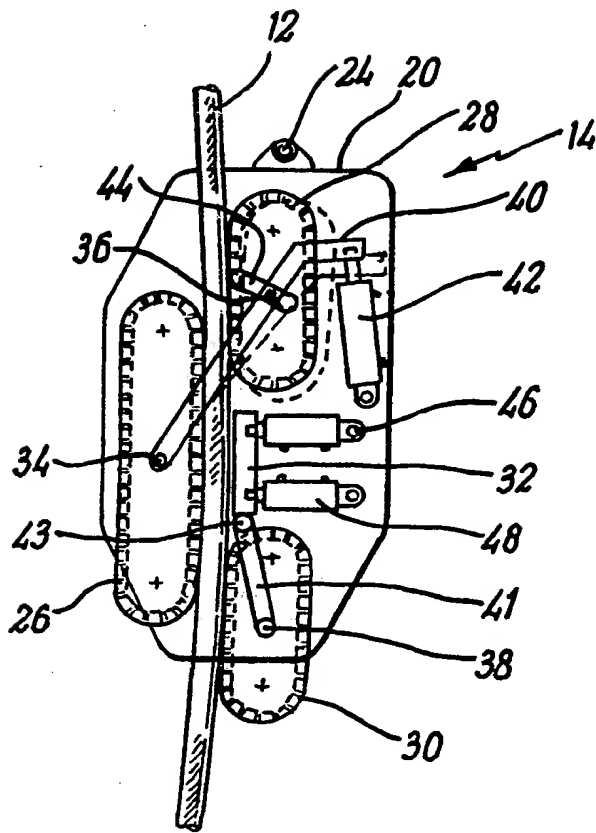


**FIG. 5**

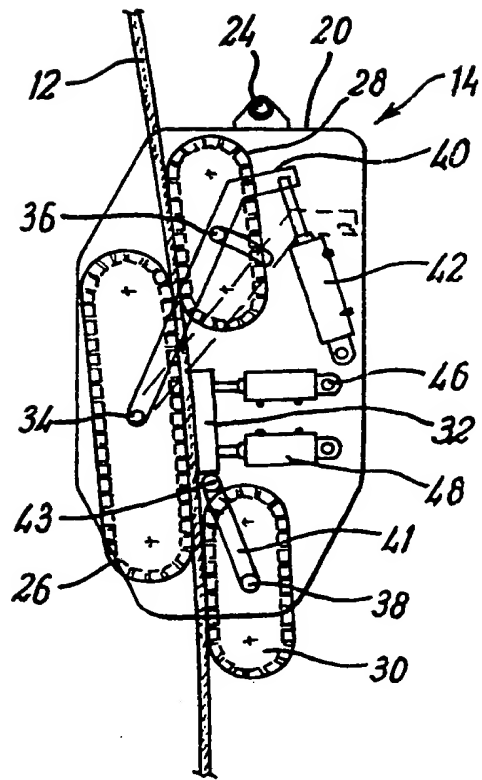


**FIG. 6**

3/4



**FIG. 7**



**FIG. 8**

4/4

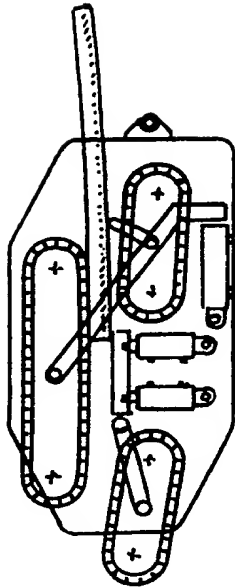


Fig. 9a

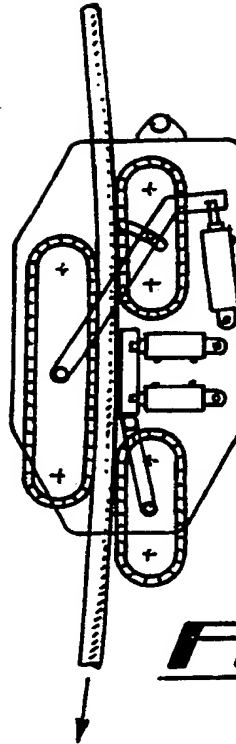


Fig. 9b

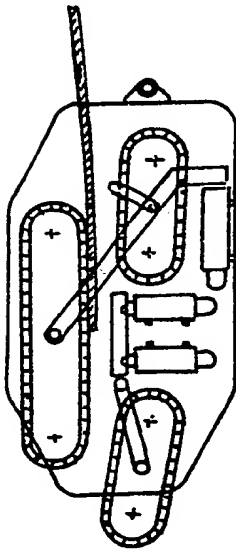


Fig. 10a

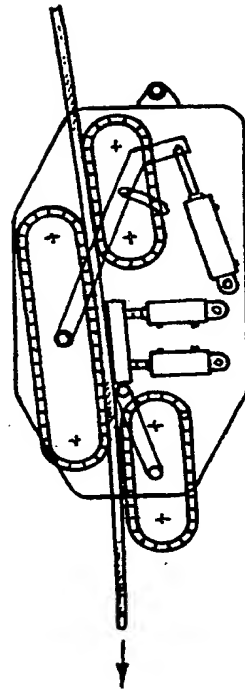


Fig. 10b

1     Improvements in or relating to Pipeline Straightening

2

3     The present invention relates to apparatus for  
4     straightening rigid walled pipeline, such as steel  
5     pipeline in marine pipelaying operations, which has  
6     been plastically deformed; e.g. by spooling onto a  
7     storage reel or by bending about a diverter shoe or the  
8     like in the course of a laying operation.

9

10    The apparatus and methods disclosed herein are  
11    particularly, but not exclusively, applicable for use  
12    in the context of the pipelaying apparatus and methods  
13    disclosed in the present applicant's co-pending UK  
14    Patent Application No. 9322424.4, filed 30 October  
15    1993. This prior Application discloses a pipelaying  
16    system whereby a drilling vessel may be adapted for  
17    pipelaying operations by means of a pipe storage reel  
18    mounted on its deck, a pipeline diverter shoe located  
19    at a height on the drilling derrick and a straightener  
20    assembly suspended from the derrick below the diverter  
21    shoe, whereby the pipeline may be straightened and laid  
22    via the moonpool of the vessel. This arrangement allows  
23    the same vessel to be used for both drilling and  
24    pipelay operations, providing the possibility of

1 exploitation of marginal hydrocarbon deposits.

2

3 Figs. 1 and 2 of the accompanying drawings show the  
4 derrick 10 of a drilling vessel adapted for pipelaying  
5 operations as described above. The pipeline 12 to be  
6 laid is fed from a storage reel (not shown), about an  
7 arcuate diverter shoe 16 mounted at a height on the  
8 derrick 10, and through a straightener assembly 14,  
9 embodying the present invention, which is suspended  
10 from existing crane hook 18 below the diverter shoe 16.  
11 The straightener assembly 14 may be raised and lowered  
12 by means of the crane hook 18 between an uppermost  
13 position adjacent the diverter shoe 16 and a lowermost  
14 position at the mouth of the moonpool (not shown) at  
15 the bottom of the derrick 10.

16

17 The apparatus operates to straighten the pipeline 12 as  
18 follows:

19

20 Firstly, with the straightening assembly 14 open and at  
21 its uppermost position, a tugger cable (not shown) is  
22 fed from a tugger winch (not shown, mounted below  
23 deck), through a pipeline clamp (not shown, mounted in  
24 the moonpool) and the straightening assembly 14, and  
25 around the diverter shoe 16 for attachment to the free  
26 end of the pipeline 12 emerging from the storage reel.  
27 The tugger winch is then operated to pull the cable and  
28 pipeline 12 over the shoe 16, and through the  
29 straightener 14 until the pipeline 12 protrudes  
30 approximately 5 metres below the straightener 14, at  
31 which point the tugger cable is disconnected.

32

33 The straightener 14 is closed and clamped to the  
34 pipeline 12 and is lowered to its lowermost position,  
35 where it is clamped by the pipeline clamp, and an

1 initiation cable (not shown) is attached. The  
2 straightener 14 is then unclamped from the pipeline 12,  
3 and is returned to its uppermost position, thereby  
4 straightening the length of pipe extending between the  
5 uppermost and lowermost positions (typically a length  
6 of about 24 metres).  
7

8 The clamp is released, the straightener 14 is again  
9 clamped to the pipeline 12 and lowered therewith to its  
10 lowermost position, the clamp re-engages the pipeline  
11 12, the straightener 14 is unclamped, and returned to  
12 its uppermost position to straighten the next length of  
13 pipe.  
14

15 This cycle of operations is repeated until the free end  
16 of the pipe achieves vertical stab-in of the initiation  
17 head at a stab-in assembly located on the sea bed,  
18 guided by the initiation cable, which extends from the  
19 end of the pipe 12, through the stab-in assembly and  
20 back to an abandonment and recovery winch (not shown,  
21 mounted below deck). Once stab-in is achieved the  
22 initiation cable is detached and the vessel proceeds  
23 with the pipelay, straightening the pipeline 12 as it  
24 is unspooled from the reel in the same manner as  
25 described above.  
26

27 The pipeline straightening technique described above is  
28 as disclosed in UK Patent Application No. 9322424.4,  
29 wherein the straightener assembly may be any one of a  
30 number of known types.  
31

32 The present invention provides a pipe straightening  
33 arrangement which is particularly suited for use in a  
34 pipelaying system of the type described above, and  
35 which may also find application in other situations



1 where pipeline straightening is required.

2  
3 In accordance with the invention there is provided  
4 pipeline straightening apparatus comprising a first,  
5 main straightening roll assembly having a pipeline  
6 contacting surface facing one side of the pipeline, in  
7 use, a second straightening roll assembly located  
8 upstream relative to the main roll in the pipeline  
9 feeding direction and having a pipeline contacting  
10 surface facing the opposite side of the pipeline, in  
11 use, and a third straightening roll assembly located  
12 downstream relative to the main roll in the pipeline  
13 feeding direction and having a pipeline contacting  
14 surface also facing said opposite side of the pipeline,  
15 said first, second and third straightening rolls being  
16 operable to engage a pipeline passing therebetween in  
17 order to effect straightening of said pipeline; said  
18 apparatus further including pipeline clamping/braking  
19 means comprising at least one brake shoe located  
20 between said second and third straightener rolls on the  
21 opposite side of said pipeline path from said main  
22 straightener roll and actuator means adapted for moving  
23 said shoe in a direction substantially perpendicular to  
24 said pipeline path towards and away from the pipeline  
25 contacting surface of said main straightener roll.

26  
27 Preferably, each of said first, second and third roll  
28 assemblies are mounted in a supporting frame for  
29 pivotable movement about respective first, second and  
30 third pivot axes extending substantially through the  
31 longitudinal centres of the respective roll assemblies  
32 and substantially at right angles to the plane of  
33 pipeline bending.

34  
35 Preferably also, said supporting frame comprises first

1 and second side plates disposed in spaced,  
2 substantially parallel relationship, said straightener  
3 rolls and clamping/braking means being located  
4 therebetween.

5  
6 Preferably also, said second, upstream roll assembly is  
7 further adapted for pivotable movement about a fourth  
8 axis located away from the longitudinal centre thereof  
9 and extending substantially at right angles to the  
10 plane of pipeline bending whereby the position of said  
11 second roll may be adjusted relative to the pipeline  
12 path.

13  
14 Preferably also, said fourth axis is coincident with  
15 said first axis, said second roll being mounted between  
16 first and second swing arms for pivotable movement  
17 about said second axis and said swing arms being  
18 mounted for pivotable movement about said fourth axis.

19  
20 Preferably also, the position of said second roll  
21 relative to said pipeline path is controlled by  
22 actuator means operably connected to said swing arms.

23  
24 Preferably also, said brake shoe is pivotably connected  
25 at a lowermost end thereof about a fifth pivot axis  
26 between first ends of third and fourth swing arms  
27 disposed on either side of said third straightener  
28 roll, second ends of said third and fourth swing arms  
29 being pivotable about said third pivot axis.

30  
31 Preferably also, said pipeline contacting surface of  
32 said main roll assembly is arcuate in longitudinal  
33 profile.

34  
35 Preferably also, said pipeline contacting surfaces of

1 said second and third rolls are substantially  
2 rectilinear in longitudinal profile.

3  
4 In accordance with a second aspect of the invention  
5 there is provided pipeline straightening apparatus  
6 comprising a first, main straightening roll assembly  
7 having a pipeline contacting surface facing one side of  
8 the pipeline, in use, a second straightening roll  
9 assembly located upstream relative to the main roll in  
10 the pipeline feeding direction and having a pipeline  
11 contacting surface facing the opposite side of the  
12 pipeline, in use, and a third straightening roll  
13 assembly located downstream relative to the main roll  
14 in the pipeline feeding direction and having a pipeline  
15 contacting surface also facing said opposite side of  
16 the pipeline, said first, second and third  
17 straightening rolls being operable to engage a pipeline  
18 passing therebetween in order to effect straightening  
19 of said pipeline; each of said first, second and third  
20 roll assemblies being mounted in a supporting frame for  
21 pivotable movement about respective first, second and  
22 third pivot axes extending substantially through the  
23 longitudinal centres of the respective roll assemblies  
24 and substantially at right angles to the plane of  
25 pipeline bending.

26  
27 Preferably, said apparatus further includes pipeline  
28 clamping/braking means comprising at least one brake  
29 shoe located between said second and third straightener  
30 rolls on the opposite side of said pipeline path from  
31 said main straightener roll and actuator means adapted  
32 for moving said shoe in a direction substantially  
33 perpendicular to said pipeline path towards and away  
34 from the pipeline contacting surface of said main  
35 straightener roll.

1 Further preferred features of the second aspect of the  
2 invention are the same as defined above in relation to  
3 the first aspect.

4  
5 An embodiment of the invention will now be described,  
6 by way of example only, with reference to the  
7 accompanying drawings, in which:

8  
9 Fig. 1 is a first side view of pipeline  
10 straightening apparatus embodying the  
11 invention suspended from the derrick of a  
12 drilling vessel adapted for pipeline laying  
13 operations, viewed in a direction  
14 perpendicular to the plane of pipeline  
15 bending;

16  
17 Fig. 2 is a second side view of the apparatus  
18 and derrick of Fig. 1 viewed along the plane  
19 of pipeline bending;

20  
21 Fig. 3 is a first schematic side view of the  
22 apparatus of Fig. 1 viewed along the plane of  
23 pipeline bending;

24  
25 Fig. 4 is a second schematic side view of the  
26 apparatus of Fig 1 viewed in a direction  
27 perpendicular to the plane of pipeline  
28 bending;

29  
30 Fig. 5 is a side view of a roller track  
31 assembly being the first of three  
32 straightening rolls of the apparatus of Figs.  
33 1 to 4;

34  
35 Fig. 6 is a side view of a roller track

1 assembly used for the second and third of the  
2 three straightening rolls of Figs 1 to 4;

3  
4 Fig. 7 is a side view of the apparatus  
5 similar to that of Fig. 4 engaging a first  
6 pipeline of relatively large diameter;

7  
8 Fig. 8 is a side view of the apparatus  
9 similar to that of Fig. 4 engaging a first  
10 pipeline of relatively small diameter;

11  
12 Figs. 9(a) and 9(b) are side views similar to  
13 Fig. 7 showing the operation of the apparatus  
14 with a pipeline of relatively large diameter;  
15 and

16  
17 Figs. 10(a) and 10(b) are side views similar  
18 to Fig. 8 showing the operation of the  
19 apparatus with a pipeline of relatively small  
20 diameter.

21  
22 Referring now to the drawings, Figs. 1 and 2 show a  
23 pipeline straightening apparatus 14 embodying the  
24 invention installed as part of a pipelaying system as  
25 described above. The purpose of the straightener  
26 assembly 14 is to impart a reverse bending force to the  
27 pipeline 12 sufficient to overcome the curvature  
28 imparted to the pipeline 12 by plastic deformation  
29 thereof during spooling onto the storage reel and/or  
30 bending around the diverter shoe 16. For this purpose  
31 three reaction points are required to be exerted on the  
32 pipe, the two end points acting in one direction and  
33 the intermediate point acting in the opposite  
34 direction, such that all three forces are substantially  
35 co-planar in the plane of bending.

1 A variety of "three-point straighteners" of this  
2 general type are known from the prior art, for example  
3 from US Patents Nos. 3,237,438; 3,641,778; 3,680,342;  
4 3,712,100; 3,855,835; 3,982,402 (RE 30,846); 4,157,023;  
5 4,230,421; 4,243,345; 4,260,287; 4,260,287 and  
6 4,687,376. These prior art straighteners generally fall  
7 into two categories: straighteners which use  
8 arrangements of individual rollers (as seen in US  
9 Patents Nos. 3,855,835; 4,157,023; 4,243,345 and  
10 4,260,287), most often used in "portable reel" systems  
11 where storage reels and associated apparatus for laying  
12 relatively small diameter pipes are temporarily  
13 installed on existing vessels; and "roller track" type  
14 straighteners which use up to five caterpillar type  
15 track assemblies for straightening and/or tensioning  
16 relatively large pipelines on purpose-built or  
17 permanently adapted vessels (as seen, for example, in  
18 US Patents Nos. 3,680,342; 3,982,402 (RE 30,846);  
19 4,230,421; 4,269,540 and 4,687,376). The present  
20 invention is concerned with the latter roller track  
21 type of straightener. Reference is made particularly to  
22 US Patent No. 3,680,342 for a detailed disclosure of  
23 roller track assemblies of the type employed in such  
24 straightener systems, and suitable also for use in the  
25 present invention. Further reference will be made to  
26 particular details of such roller track assemblies in  
27 the course of the following description.

28  
29 Referring now to Figs. 3 to 6 of the drawings,  
30 straightener apparatus 14 embodying the invention  
31 comprises a self-contained assembly in which all of the  
32 major components are mounted between first and second  
33 side plates 20, 22, the assembly 14 having a padeye 24  
34 located at an upper end thereof whereby it may be  
35 suspended in use, for example from the crane hook 18 of

1 the derrick 10 as seen in Figs. 1 and 2. The main  
2 components of the apparatus comprise a first, main  
3 roller track assembly, or "straightening roll", a  
4 second, upper roller track assembly 28, a third, lower  
5 roller track assembly 30 and a pipeline  
6 braking/clamping shoe 32. In use, the pipeline 12  
7 passes through the assembly 14 between the main roll  
8 26, disposed on one side of the pipeline path, and the  
9 upper and lower rolls 28, 30 disposed on the opposite  
10 side of the pipeline path and respectively upstream and  
11 downstream of the main roll 26 in the direction of  
12 pipeline unspooling. The braking/clamping shoe 32 is  
13 located between the upper and lower straightener rolls  
14 28, 30, facing the pipeline contacting surface of the  
15 main roll 26.

16  
17 Each of the first, second and third straightener rolls  
18 26, 28, 30 are mounted for pivotable movement about  
19 respective pivot axes 34, 36, 38, extending  
20 substantially through the longitudinal centres of the  
21 respective straightener rolls 26, 28, 30 perpendicular  
22 to the plane of pipeline curvature (i.e. perpendicular  
23 to the side plates 20, 22).

24  
25 The first and third straightener rolls 26, 30 are  
26 pivotably mounted between the side plates 20, 22. The  
27 second roll 28 is pivotably mounted between a pair of  
28 swing arms 40, of which only one is visible in the  
29 drawings, the swing arms 40 themselves being pivotable  
30 about a fourth pivot axis, which is conveniently  
31 coincident with the first pivot axis 34 of the first  
32 roll 26. The first and third rolls 26, 30 are thus  
33 pivotably movable about their respective pivot axes 34,  
34 38, whilst the second roll is pivotable about its pivot  
35 axis 36 and movable towards and away from the pipeline

1 path by pivoting movement of the swing arms 40 about  
2 the first axis 34.

3  
4 In order to effect adjustment of the position of the  
5 second roll 28 relative to the pipeline path, a  
6 hydraulic or pneumatic cylinder 42, or other suitable  
7 actuator means, is mounted between the side plates 20,  
8 22, with its working end connected to the free ends of  
9 the swing arms 40 remote from their pivot axis 34. The  
10 central pivot pin of the second straightener roll 28  
11 extends into arcuate guide slots 44 formed in the side  
12 plates 20, 22, of which only one is visible in the  
13 drawings, to guide and limit the movement of the swing  
14 arms 40.

15  
16 The position of the swing arm pivot axis may be varied  
17 from that shown. It is generally desirable for the axis  
18 to be downstream of the second roll 28 on the opposite  
19 side of the pipeline path therefrom, and to be at a  
20 sufficient distance from the second roll 28 to provide  
21 a reasonable lever arm. It is structurally convenient  
22 and advantageous for the swing arms 40 to pivot about  
23 the same axis as the main roll 26, but this is not  
24 essential to the operation of the apparatus.

25  
26 The braking/clamping shoe 32 is mounted on second and  
27 third hydraulic or pneumatic cylinders 46, 48 mounted  
28 between the side plates 20, 22, or other suitable  
29 actuator means, for movement in a direction  
30 substantially perpendicular to the pipeline path in the  
31 plane of pipeline bending. The lowermost end of the  
32 brake shoe 32 is pivotably connected about a fifth  
33 pivot axis 43 between first ends of a further pair of  
34 swing arms 41, of which only one is visible in the  
35 drawings, the other ends of the swing arms 41, which



1 are disposed on either side of the third straightener  
2 roll 30, are pivoted about the third pivot axis 38  
3 about which the third roll 30 itself pivots.

4  
5 As previously indicated, the straightener rolls 26, 28  
6 and 30 are of a generally known type, comprising an  
7 endless caterpillar type roller track 50, 52 rotatable  
8 around the periphery of a supporting structure 54, 56.  
9 The tracks 50, 52 each comprise a plurality of linked  
10 blocks having a transverse arcuate or v-shaped profile  
11 (not shown) for seating against the pipeline surface.  
12 The pipe contacting portions of the blocks may be faced  
13 with polyurethane or the like to protect the pipeline.  
14 Reference is made to US Patent No. 3,680,342 for a more  
15 detailed discussion of these and other aspects of  
16 straightener rolls of this type. It should also be  
17 understood that the caterpillar tracks 50, 52 might be  
18 replaced by a series of discrete rollers rotatably  
19 mounted in the support structures 54, 56 along the  
20 pipeline facing side thereof, as is also known in the  
21 art.

22  
23 The braking/clamping shoe 32 may have a similar  
24 configuration to one of the blocks of the caterpillar  
25 tracks 50, 52, but being relatively larger,  
26 particularly in terms of longitudinal length.

27  
28 The main straightener roll 26 is generally longer than  
29 the second and third rolls 28, 30, and the pipe  
30 contacting face 58 thereof is preferably arcuate in  
31 longitudinal profile. The radius of longitudinal  
32 curvature of the face 58 may be fixed at a value which  
33 suits a range of pipeline diameters, or the roll  
34 assembly may be adapted to allow variation of the  
35 radius of curvature so as to be optimised for

1 particular pipeline diameters. A straightener roll  
2 having variable curvature is disclosed in US Patent No.  
3 4,687,376. The second and third straightener rolls 28,  
4 30 are relatively shorter than the main roll 26 and  
5 their pipeline contacting faces are substantially  
6 rectilinear in longitudinal profile.

7  
8 The braking/clamping shoe 32, in cooperation with the  
9 main roll 26, performs pipeline clamping and braking  
10 functions, so that the straightener rolls 26, 28 and 30  
11 may be unpowered (i.e. their tracks or rollers do not  
12 have to be driven) and only the second roll 28 need be  
13 movable relative to the pipeline path so as to adjust  
14 the apparatus for straightening pipelines of different  
15 diameters. Prior art straighteners include adjustable,  
16 powered straightener rolls which may perform clamping  
17 and tensioning/braking functions in addition to  
18 straightening. The present apparatus provides a  
19 simplified arrangement which is less costly to  
20 construct and which is relatively simpler and quicker  
21 to set up in comparison with prior art systems.

22  
23 In use of the present apparatus in the pipelaying  
24 system illustrated in Figs. 1 and 2, the  
25 braking/clamping shoe 32 serves firstly for clamping  
26 the pipeline 12 while the straightener is initially  
27 lowered from its upper position to its lower position,  
28 and subsequently to tension the pipeline during the  
29 straightening phase of each cycle of operation.

30  
31 Figs. 7 and 8 show side views of the apparatus of Figs.  
32 3 to 6 adjusted for six inch and two inch diameter  
33 pipelines respectively by appropriate adjustment of the  
34 pistons of the roll and brake shoe cylinders 42, 46,  
35 48. The relative positions of the second straightener

1 roll 28, swing arms 40 and brake shoe 32 can be seen by  
2 comparison of the drawings. Figs. 9 and 10 show the  
3 "snap-action" operation of the apparatus in engaging  
4 the pipeline after initial feeding through the  
5 apparatus, again for six and two inch diameter  
6 pipelines respectively. In each case the second roll 28  
7 and brake shoe 32 are initially retracted clear of the  
8 pipeline path, allowing the pipeline 12 to be fed  
9 through the apparatus. The first cylinder 42 and the  
10 brake cylinders 48, 50 are then operated to bring the  
11 second roll 28 and brake shoe 32 into engagement with  
12 the pipeline 12 as required. The three straightener  
13 rolls 26, 28, 30 pivot about their respective axes to  
14 orient themselves with the pipeline.

15  
16 The straightening apparatus as herein described has  
17 significant advantages in terms of its simplicity of  
18 construction and operation, and its configuration as a  
19 relatively compact, self-contained assembly is  
20 advantageous, being readily portable for installation  
21 as part of the temporary adaptation of a vessel for  
22 pipelaying operations and requiring external power  
23 supplies only for the swing arm and brake shoe  
24 actuators.

25  
26 Improvements and modifications may be incorporated  
27 without departing from the scope of the invention.

28

1     Claims

2  
3     1. Pipeline straightening apparatus comprising a  
4     first, main straightening roll assembly having a  
5     pipeline contacting surface facing one side of the  
6     pipeline, in use, a second straightening roll assembly  
7     located upstream relative to the main roll in the  
8     pipeline feeding direction and having a pipeline  
9     contacting surface facing the opposite side of the  
10    pipeline, in use, and a third straightening roll  
11    assembly located downstream relative to the main roll  
12    in the pipeline feeding direction and having a pipeline  
13    contacting surface also facing said opposite side of  
14    the pipeline, said first, second and third  
15    straightening rolls being operable to engage a pipeline  
16    passing therebetween in order to effect straightening  
17    of said pipeline; said apparatus further including  
18    pipeline clamping/braking means comprising at least one  
19    brake shoe located between said second and third  
20    straightener rolls on the opposite side of said  
21    pipeline path from said main straightener roll and  
22    actuator means adapted for moving said shoe in a  
23    direction substantially perpendicular to said pipeline  
24    path towards and away from the pipeline contacting  
25    surface of said main straightener roll.

26  
27    2. Pipeline straightening apparatus as claimed in  
28    Claim 1, wherein each of said first, second and third  
29    roll assemblies are mounted in a supporting frame for  
30    pivotable movement about respective first, second and  
31    third pivot axes extending substantially through the  
32    longitudinal centres of the respective roll assemblies  
33    and substantially at right angles to the plane of  
34    pipeline bending.

35

1     3.     Pipeline straightening apparatus comprising a  
2     first, main straightening roll assembly having a  
3     pipeline contacting surface facing one side of the  
4     pipeline, in use, a second straightening roll assembly  
5     located upstream relative to the main roll in the  
6     pipeline feeding direction and having a pipeline  
7     contacting surface facing the opposite side of the  
8     pipeline, in use, and a third straightening roll  
9     assembly located downstream relative to the main roll  
10    in the pipeline feeding direction and having a pipeline  
11    contacting surface also facing said opposite side of  
12    the pipeline, said first, second and third  
13    straightening rolls being operable to engage a pipeline  
14    passing therebetween in order to effect straightening  
15    of said pipeline; each of said first, second and third  
16    roll assemblies being mounted in a supporting frame for  
17    pivotable movement about respective first, second and  
18    third pivot axes extending substantially through the  
19    longitudinal centres of the respective roll assemblies  
20    and substantially at right angles to the plane of  
21    pipeline bending.

22  
23    4.     Pipeline straightening apparatus as claimed in  
24    Claim 3, further including pipeline clamping/braking  
25    means comprising at least one brake shoe located  
26    between said second and third straightener rolls on the  
27    opposite side of said pipeline path from said main  
28    straightener roll and actuator means adapted for moving  
29    said shoe in a direction substantially perpendicular to  
30    said pipeline path towards and away from the pipeline  
31    contacting surface of said main straightener roll.

32  
33    5.     Pipeline straightening apparatus as claimed in  
34    Claim 2, Claim 4, wherein said supporting frame  
35    comprises first and second side plates disposed in

1 spaced, substantially parallel relationship, said  
2 straightener rolls and clamping/braking means being  
3 located therebetween.  
4

5 6. Pipeline straightening apparatus as claimed in any  
6 one of Claims 2, 3, 4 or 5, wherein said second,  
7 upstream roll assembly is further adapted for pivotable  
8 movement about a fourth axis located away from the  
9 longitudinal centre thereof and extending substantially  
10 at right angles to the plane of pipeline bending  
11 whereby the position of said second roll may be  
12 adjusted relative to the pipeline path.  
13

14 7. Pipeline straightening apparatus as claimed in  
15 Claim 6, wherein said fourth axis is coincident with  
16 said first axis, said second roll being mounted between  
17 first and second swing arms for pivotable movement  
18 about said second axis and said swing arms being  
19 mounted for pivotable movement about said fourth axis.  
20

21 8. Pipeline straightening apparatus as claimed in  
22 Claim 7, wherein the position of said second roll  
23 relative to said pipeline path is controlled by  
24 actuator means operably connected to said swing arms.  
25

26 9. Pipeline straightening apparatus as claimed in  
27 Claim 7 or Claim 8 when dependent from Claim 2, Claim 4  
28 or Claim 5, wherein said brake shoe is pivotably  
29 connected at a lowermost end thereof about a fifth  
30 pivot axis between first ends of third and fourth swing  
31 arms disposed on either side of said third straightener  
32 roll, second ends of said third and fourth swing arms  
33 being pivotable about said third pivot axis.  
34

35 10. Pipeline straightening apparatus as claimed in any

1 preceding Claim, wherein said pipeline contacting  
2 surface of said main roll assembly is arcuate in  
3 longitudinal profile.  
4

5 11. Pipeline straightening apparatus as claimed in any  
6 preceding Claim, wherein said pipeline contacting  
7 surfaces of said second and third rolls are  
8 substantially rectilinear in longitudinal profile.  
9

10 12. Pipeline straightening apparatus substantially as  
11 hereinbefore described with reference to the  
12 accompanying drawings.  
13

**Relevant Technical Fields**

(i) UK Cl (Ed.N) F2P PL2, P2A1, B3E ECB

(ii) Int Cl (Ed.6) F16L 1/20 1/12, 1/16, 1/18

**Databases (see below)**

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Search Examiner  
 MR S WALLER

Date of completion of Search  
 17 MAY 1995

Documents considered relevant  
 following a search in respect of  
 Claims :-  
 1-12

**Categories of documents**

- |  |   |
|--|---|
| <p><b>X:</b> Document indicating lack of novelty or of inventive step.</p> <p><b>Y:</b> Document indicating lack of inventive step if combined with one or more other documents of the same category.</p> <p><b>A:</b> Document indicating technological background and/or state of the art.</p> | <p><b>P:</b> Document published on or after the declared priority date but before the filing date of the present application.</p> <p><b>E:</b> Patent document published on or after, but with priority date earlier than, the filing date of the present application.</p> <p><b>&amp;:</b> Member of the same patent family; corresponding document.</p> |
|--|---|

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1599865	(SANTA FE) see Figure 5B	3
X	US 3872680	(BROWN & ROOT) see Figures 3 and 4	3, 10
X	US 3237438	(TESSON) see Figures 3 and 4	3, 11



RECEIVED

APR 17 2001

TC 3600 MAIL ROOM